Comparable Pavement Designs at GDOT

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Comparable Pavement Designs

- **Current Design Practice**
- Constraints of the Current Practice
- Interim Direction for Comparable Designs

Flexible Pavement Design

- Based on the 1972 AASHTO Interim Guide for the Design of Pavement Structures
  - INPUTS: Soil Support Value, Regional Factor, Traffic Volumes and Truck percentages
  - OUTPUT: Structural Number (SN)

Flexible Pavement Design

- Layer Thicknesses (D_i) are multiplied by appropriate layer coefficients (a_i)
  - $SN = a_{surface} D_{surface} + a_{binder} D_{binder} + a_{base\ AC} D_{base\ AC} + a_{GAB} D_{GAB}$
- The aggregate base course is part of the pavement structure

Typical Flexible Layer Thicknesses

- $D_{surface}$ >> 1.25 or 1.5 inches
- $D_{intermediate}$ >> 2 inches
- $D_{base\ AC}$ >> 3 inches minimum
- D_{GAB} >> 8,10, or 12 inches

Rigid Pavement Design Method

- Based on the 1981 Revision of the 1972 Interim AASHTO Design Guide
  - INPUTS: Effective Modulus of Subgrade Reaction (k_{eff}), Modulus of Rupture, Traffic Volumes, and Truck percentages
  - OUTPUT: slab thickness (D)

Typical Rigid Design Inputs

- Subgrade
  - $k_{Subgrade}$ ranges from 110 to 200 pci
- Interlayer
  - $D_{AC\ Interlayer}$: 3 inches of 19 mm SP
- Aggregate Base
  - D_{GAB} : 8,10, or 12 inches

Typical Rigid Design Inputs

- Concrete
  - Modulus of Rupture f_r = 600 psi
  - Design Tensile Strength
    $f_t = 0.75 * f_r$ => 450 psi
  - E_c = 3,200,000 psi

Other Rigid Design Inputs

- Traffic loading volumes are same as in Flexible Design.
  - Rigid ESAL factors are higher.
- Load Transfer Coefficient (J) of 3.2
  - Assumes little edge support
- Reliability of 80% - 85%

ESAL Factors Used

- MU
  - Flexible = 1.500
  - Rigid = 2.680
- SU
  - Flexible = 0.400
  - Rigid = 0.500
- Vehicles
  - Flexible is not calculated
  - Rigid = 0.004

Comparable Pavement Designs

- Current Design Practice
- **Constraints of the Current Practice**
- Interim Direction for Comparable Designs

Constraints of the Current Practice

- The same GAB thickness is used for both pavement types
  - Geotechnical recommendation
- Flexible pavements are under-designed by 10%-15%
  - To allow future resurfacing in 10 years

Constraints: cont'd

- Rigid pavements are not under-designed
  - Difficult to overlay JPC with a thin JPC layer
- Rigid pavements have an interlayer
  - Permeability
- Total thicknesses of rigid pavements are greater than the flexible pavements

In General

- With a Soil Support Value of 2.0,
  - The required GAB layer thickness is 12 inches
  - The SN of the GAB is 1.92

And

- For the same soil, the k value of the subgrade is 110 pci,
  - The required GAB layer is also 12 inches
  - The rigid pavement has an additional layer of 3 inches of 19 mm SP
  - The effective k value (k_{eff}) is 260 pci

Heavy State Route Example

- Required flexible pavement
  - Required SN = 6.4±
  - Required Structure
    - 10.5 inches AC
    - 12 inches of GAB (30% Contribution)
- Required rigid pavement
  - Required Thickness = 10.3 inches
  - Additional Structure
    - 3 inches of 19 mm SP
    - 12 inches of GAB

Local Collector Example

- Required flexible pavement
  - Required SN = 4.7±
  - Required Structure
    - 6.5 inches AC
    - 12 inches of GAB (41% Contribution)
- Required rigid pavement
  - Required Thickness = 7 inches
  - Additional Structure
    - 3 inches of 19 mm SP
    - 12 inches of GAB

Another Look at Heavy State Routes

- Without the GAB and AC Interlayer,
  - $k_{eff} = k_{subgrade} = 110$ pci
  - 10.8 inches of JPC Pavement is needed
- With the GAB and AC Interlayer
  - $k_{eff} = 260$ pci
  - 10.3 inches of JPC Pavement is needed
  - Therefore, the GAB and Interlayer system reduced the total slab thickness by 5%

Another Look at Local Collectors

- Without the GAB and AC Interlayer,
  - $k_{eff} = k_{subgrade} = 110$ pci
  - 7.5 inches of JPC Pavement is needed

- With the GAB and AC Interlayer
  - $k_{eff} = 260$ pci
  - 7 inches of JPC Pavement is needed
  - Therefore, the GAB and Interlayer system reduced the total slab thickness by 7%

Design Summary

- In the flexible pavement, the GAB layer is an essential element of the final structure.
  - 30 to 40% of the SN
- In the rigid pavement, the GAB layer and the asphalt concrete Interlayer are
  - 5 to 10% of the thickness

Design Considerations

- Should the GAB layer and asphalt interlayer be eliminated?
  - ***NO***. They are needed for handling constructability and permeability issues
- Can the GAB layer and asphalt interlayer be reduced?
  - ***YES.*** On state routes and not interstates.

History of the Current Practice

- GDOT up to early 2000's used to selectively use AC Interlayer on state route projects
- Interlayer was omitted when traffic volumes do not justify the additional costs
- Interlayer was used on Interstates

Performance

- These pre-2000 PCC Pavements with no interlayer are showing good performance
  - I-285 in Decatur County b/w I-20 to I-85
  - GA 400 in Fulton and Forsyth Counties
  - Zell Miller Parkway
- The newer PCC Pavements without the interlayer are also showing good performance to date
  - Homer Bypass

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- **Interim Direction for Comparable Designs**

Proposed Direction For Comparable Designs

Implement MEPDG…

...In 2 – 3 years

BUT In the meantime…

Interim Direction For More Comparable Designs

- **Base Guidelines**
  - If SSV < 3.0, use 10 inches GAB
  - If SSV ≥ 3.0, use 8 inches GAB
- **Interlayer Guidelines**
  - For Interstates, use 3 inches of 19 mm SP
  - For State Routes, 3 inches of 19 mm SP is waived, unless truck traffic (volume, ESALs, etc…) warrant its use.

Comparison of Designs

- The following pavement designs were prepared for
  - Life Cycle Cost Analysis (LCCA) / Pavement Type Selection (PTS)
  - Used Old and Interim Design Guidelines for Comparison

Old and Interim GAB Layers

SSV	$k_{subgrade}$	GAB_{old}	$GAB_{interim}$
2	110	12	10
2.5	130	12	10
3.0	150	10	8
3.5	175	10	8

Old And Interim AC Interlayer And k_{design}

Old		Interim	
Interlayer	k_{design}	Interlayer	k_{design}
3	260	0	175
3	280	0	195
3	270	0	195
3	300	0	215

Pavement Designs for SSV = 2.0

Flexible		Old Rigid		Interim Rigid	
AC Layer (inches)	GAB Layer (inches)	Slab Depth (inches)	GAB Layer (inches)	Slab Depth (inches)	GAB Layer (inches)
9.5	12	**8.3**	**12**	**8.5**	**10**
$AADT_{20\ year}$ = 11,550 MU=1 SU=3		Interlayer = 3 in k_{design} = 260 pci		Interlayer = 0 in k_{design} = 175 pci	

Pavement Designs for SSV = 2.5

Flexible		Old Rigid		Interim Rigid	
AC Layer (inches)	GAB Layer (inches)	Slab Depth (inches)	GAB Layer (inches)	Slab Depth (inches)	GAB Layer (inches)
6.25	12	**7.1**	**12**	**7.6**	**10**
$AADT_{20\ year}$ = 4720 MU=1 SU=5		Interlayer = 3 in k_{design} = 280 pci		Interlayer = 0 in k_{design} = 195 pci	

Pavement Designs for SSV = 2.5

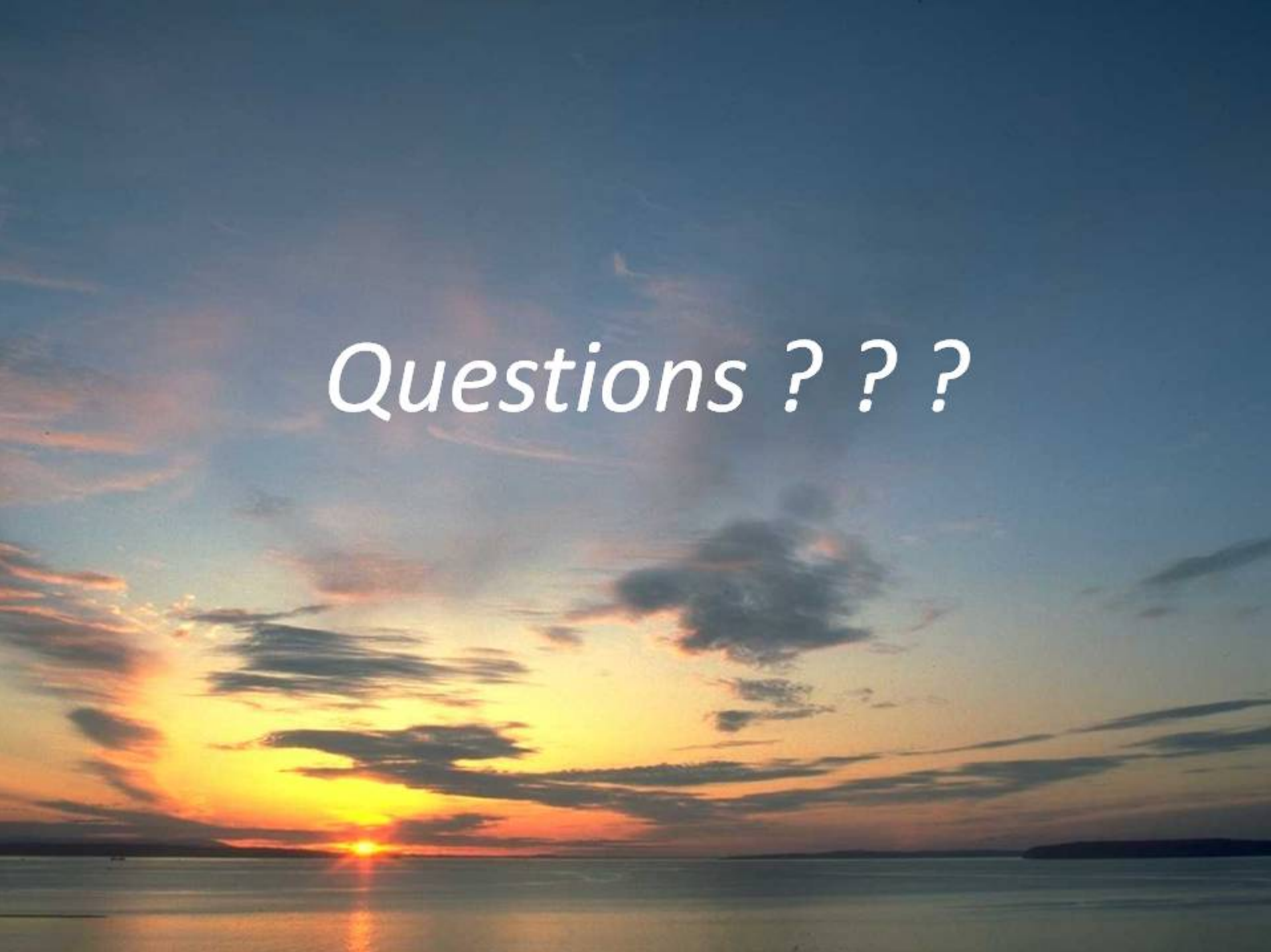
Flexible		Old Rigid		Interim Rigid	
AC Layer (inches)	GAB Layer (inches)	Slab Depth (inches)	GAB Layer (inches)	Slab Depth (inches)	GAB Layer (inches)
11.5	12	**10.2**	**12**	**10.4**	**10**
$AADT_{20\ year}$ = 9900 MU=6 SU=4		Interlayer = 3 in k_{design} = 280 pci		Interlayer = 0 in k_{design} = 195 pci	

Pavement Designs for SSV = 3.0

Flexible		Old Rigid		Interim Rigid	
AC Layer (inches)	GAB Layer (inches)	Slab Depth (inches)	GAB Layer (inches)	Slab Depth (inches)	GAB Layer (inches)
11.5	12	**11.6**	**12**	**11.9**	**8**
$AADT_{20\ year}$ = 18,200 MU=7 SU=7		Interlayer = 3 in k_{design} = 270 pci		Interlayer = 0 in k_{design} = 195 pci	

Pavement Designs for SSV = 3.5

Flexible		Old Rigid		Interim Rigid	
AC Layer (inches)	GAB Layer (inches)	Slab Depth (inches)	GAB Layer (inches)	Slab Depth (inches)	GAB Layer (inches)
6.5	12	**10.3**	**12**	**10.6**	**8**
$AADT_{20\ year}$ = 8775 MU=8 SU=3		Interlayer = 3 in k_{design} = 300 pci		Interlayer = 0 in k_{design} = 215 pci	


Questions ? ? ?